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Biomedical Waste Handling Practices among Healthcare Workers at Mombasa Sub County Hospitals Kenya

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ABSTRACT

Developing countries lack proper segregation practices leading to biomedical waste management. (Muhwezi, 2014). This has led to accidental injections with contaminated syringes causing 21 million hepatitis B virus (HBV) infections, 2 million hepatitis C virus (HCV) infections, and 260,000 HIV infections globally(HCWMP 2016-2021). The aim of this study was to assess the biomedical waste handling practices amongst healthcare workers in Mombasa County hospitals. Cross-sectional study design, stratified random. Data collection instrument were structured questionnaire and observational charts. Data was analyzed using SPSS Version 22 where comparison of mean by ANOVA was used to test significance of the results at 0.05 significant levels. Despite having knowledge on segregation and risks of exposure to biomedical waste 71.1%(1.17±0.157) of the respondents were exposed to biomedical hazards, sanitary staff(15.6% (2.11±0.123))of the respondents were less educated (certificate the highest level) and lacked key information on biomedical waste guidelines of precautionary principle and government strategic plan on hospital waste management. 42.2 %(1.21±0.091) of the respondents lacked adequate supply of color-coded waste containers leading to mixing of biomedical waste. 36.7 %(1±0.00) of the respondents were informed of government medical waste management plan while 63.3% (1.14±0.46) had no idea P=0.277(>0.05). In conclusion, waste handling practices in Mombasa sub county hospitals are inadequate in relation to WHO,2014 guidelines due to deficient segregation and handling equipment and low level of awareness. I therefore recommend the review of the current waste management program and development of a more proactive approach that will ensure adequate supply of waste handling equipments and improve awareness on proper handling practices.

Introduction

The healthcare industry just like any other industry that involves human activities produces waste. According to (ICRC, 2011) and (WHO, 2014), 75-90% of the HCW are similar to domestic waste or municipal waste and the remaining 10-25% are hazardous which calls for exceptional attention in their management. In Africa, estimated average HCW generation is as follows: Primary Healthcare clinics: 0.1kg per patient per day, small district hospitals: 1kg per patient per day, General hospitals: 2kg per patient per day and Major Teaching and Referral hospitals: 4kg per patient per day (Enyenu, 2013), World Bank Agenda for Environment and Responsible Development in 2009. Africa has estimated 67740 health facilities generating 282447 tons and the composition of waste every year and most of these wastes are dumped without treatment in open dumps without treatment and poorly functioning incinerators (Udofia, *et al*., 2015). Healthcare workers, especially the nursing workforce are at a great risk of infection through injuries contaminated sharps. Healthcare waste handlers and other personnel working outside health care establishments are also at significant risk but much lower among patients and the public. In general, however, the scenario continues to be difficult to assess, especially in developing countries. It is suspected that a high incidence rate of infections with a wide range of pathogens have been as a result of exposure to inappropriately managed healthcare wastes in developing countries (WHO, 2014).

The risks involve serious viral infections such as HIV/AIDS and hepatitis B and C. World Health Organization (WHO) estimated in year 2000 that sharps accidents accounted for over 66,000 cases of infection with the HBV, 16,000 cases with HCV and 200 to 5,000 cases of HIV infections amongst the healthcare (ICRC, 2011). In Kenya Sub-County Hospital, the Level of adherence to waste disposal guidelines was low (16.3%) and insignificantly different among nurses and waste handlers, which results compliance, remains a key challenge. This low adherence rates means health workers and people living within health facilities are at great risk of environmental and health hazards associated with waste, in addition to diseases (Njue, *et al.*,

2015). In Africa, World Health Organization and World Bank Agenda estimate average HCW generation for Small District hospitals for Environment and Responsible Development to 1kg per patient per day (Enyenu, 2013).

According to USAID, (2012) in 111 facilities across Kenya, it was found that only 7.2% were compliant on incineration, waste water- 19.2%, respirators- 29.0%, segregation- 59.5%. Notably though, 96.3% of the facilities were compliant on sharps management. Accidental injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections), two million hepatitis C virus (HCV) infections (40% of all new infections), and 260,000 HIV infections (5% of all new infections) globally.

More than 2 million health-care workers exposed to per-coetaneous injuries with infected sharps every year (HCWSP, 2016-2021). This is due to, most medical facilities outsource the services of private firms with no or limited capacities to handle medical wastes while employees of these companies have limited education, poor training, and lack equipments for personal protection and effectively handle the biohazards (Muhwezi, 2014). Waste handlers are largely underequipped across all levels of facilities and lack appropriate protective gear for waste handling.

Adherence to various GOK regulations and WHO guidelines across 111 facilities surveyed found that all facilities were noncompliant with Level 3 and 4 facilities in Kenya were worst off. For instance, healthcare wastes originating from healthcare facilities are dumped either into their backyard in a simple pit or put in open garbage to bins (USAID, 2012). HCWHs lack knowledge on healthcare waste type, knowledge on potentiality of HCW to transmit infections, training and availability of guideline documents (Muluken, *et al. 2013*,). This study will focus on Tudor, Portreitz, and Likoni Sub-County hospitals that fall under these categories of healthcare facilities. The study will focus on evaluating how these shortfalls have affected the HCWH exposure to biohazards.

Materials and methods

Study site

The study was carried out at Tudor, Portreiz and Likoni sub county hospitals in Mombasa county.

Study design

This study employed a descriptive cross-sectional design.

Study Population

The study population focused was sanitary staff, doctors, Clinicians and the nursing staff. According to WHO (2014), nursing workforce, doctors, clinicians waste collectors and cleaners face the highest risk of exposure to biohazards.

The total nursing population in the three Sub-County hospitals was 61, doctors 18, Clinicians 26, laboratory technologists 10 and that of waste collectors and cleaners is 35.

Sample Size Determination and Sampling Method

The sample size was determined using Atchleys formula (Saunders and Thornhill, 2009).

$$n = \frac{z^2 p(1-p)}{d^2}$$

$\boldsymbol{n}$= desired sample size

$\boldsymbol{p}$= proportion in target group or prevalence estimated to have the measured character.

$\boldsymbol{Z}$= reliability co-efficient or standard normal deviation at the required confidence level

$\boldsymbol{d}$= the level of statistical significance or degree of freedom, so if

$\boldsymbol{z}$= reliability co-efficient $(\mathbf{1.96})$

$\boldsymbol{p}$= prevalence $(\mathbf{16.3\%})$ source (Njue *et al* 2015)

$\boldsymbol{d}$= degree of freedom $(\mathbf{0.05})$

$$\boldsymbol{n = \frac{1.96^2 \times 0.163(1-0.163)}{0.05^2}}$$

The required sample was $\boldsymbol{n = 210}$

But since target population is way below 10,000 the final sample estimate $(\boldsymbol{n_f})$ will be calculated using $\boldsymbol{n_f = \frac{n}{1+{}^{n}/_{N}}}$

Where;

$\boldsymbol{N}$ Was the estimated study population and $\boldsymbol{n}$ is the required sample size.

Study population size, $\boldsymbol{N}$= 256

Therefore, $\boldsymbol{n_f = \frac{210}{1+210/256} = 116}$

The final sample size estimate, $\boldsymbol{n_f}$;

116+10% (attrition rate) = 128

Sampling technique

A stratified random sampling approach was used in selection of the subjects by first identifying the population of the targeted respondents (nurses, clinical officers, Doctors, laboratory technologists and sanitary staff) then apply the simple random method to determine the study participants from each strata proportionately. All the three sub county hospital were sampled and the sample size distributed equally per each facility as the study population is equally distributed (table 1). This study design applied the principle of picking the subjects randomly hence reducing the selection bias.

Instruments for data collection

Structured questionnaires observation chart were utilized to determine the waste practices assessment (segregation, storage, transportation, treatment, and disposal). This was done in accordance with fundamental guidelines from the (World Health Organization, National Environmental Management Authority, and The Health Care Waste Management Plan, 2016-2021).

Data collection procedure

This was done using Questionnaire and Observation chart Research assistants administered the questionnaires. This is after they underwent a two days training prior to data collection. This was necessary because some respondent had

Table 1. Sample distribution.

Carder	Population				Sample			
Carder	**portreiz**	**Tudor**	**Likoni**	**Total**	**Portreiz**	**Tudor**	**Likoni**	**Total**
Doctors	10	9	5	24	5	4	3	12
Clinical Officer	15	12	7	34	8	6	3	17
Nurses	92	25	20	137	46	13	10	69
Sanitary staffs	12	6	10	28	6	3	5	14
Lab Technologist	9	5	6	20	5	2	3	10
Dentists	6	2	5	13	3	1	2	6
Total	144	59	53	256	73	29	26	128

limited education and therefore required rephrasing of questions. Observation and recording of the finding was done by the use of predesigned observation check to collaborate what the respondents said and the actual practice.

Data processing and analysis

The data obtained from the questionnaires were cleaned, coded, and tabulated. The data was then analyzed using the Statistical Package for the Social Sciences, version 22.0 where comparison of means was done by ANOVA to determine significance of findings. WHO (2014), Health Care Waste Management Plan, (2016-2021), and environmental management legal frameworks were used to validate the collected data by comparison.

Ethical considerations

The research involved human subjects as the main source of Data. Therefore all the details, intentions , objectives and procedures were subjected to ethical committee review for approval, after which the research participants were fully informed of all the details of research and there after allowed to make informed decision on whether to take part or not. The details of research participant remained secured and findings kept confidential.

RESULTS

Demographics

28.9% (1.71±0.056) were male, 71.1% (1.57±0.056) were female (Fig 1).

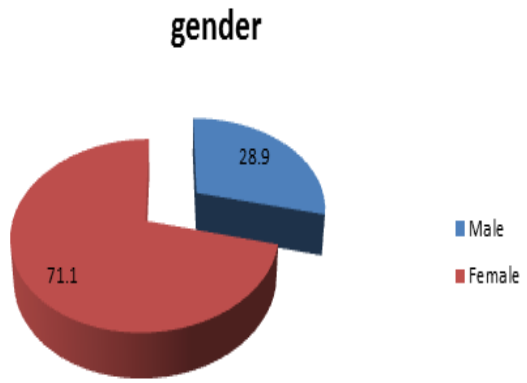

Figure 1. genders of the respondents.

Among the respondents, those aged between 41-50 years were 46.7% (1.53±0.053), followed by 31-40 at 34.4% (1.66±0.050), then 21-30 10% (1.9±0.032) while those above 50 years were 8.9% (1.91±0.030) (Figure 2).

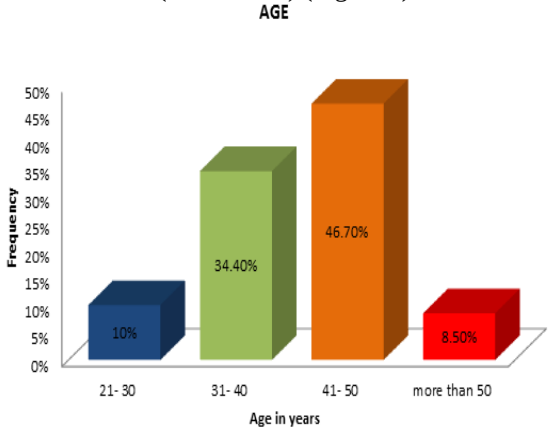

Figure 2 Age distribution of the respondents

Among the respondents, trained health workers with diploma level were 44.4% (1.53±0.053), while certificate 10% (1.90±0.032), secondary education 16.6% (1.83±0.040), primary education 10% (1.90±0.032), while those with degrees/masters were 19% (1.79±0.043) (Fig. 3).

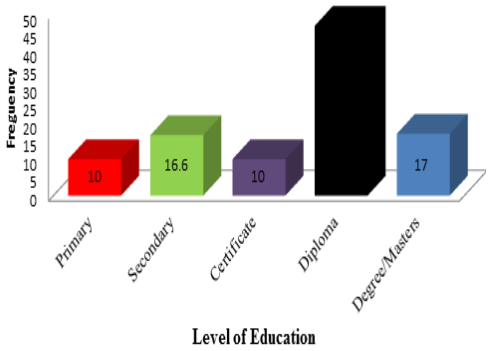

Figure 3. level of education of the respondents.

4.2.1 Employment status

34.4% (2.42±0.196) were nurses, clinical officers 18.8% (2.47±0.125) doctors 4.4% (2.33±0.142), laboratory technologists 11.1% (2.10±0.10) sanitary staff 15.6%(2.11±0.132) and dentists6.6%(3.00±0.0)(Fig.4).

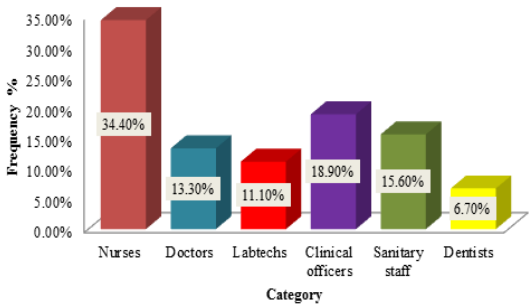

Figure 4. job cadre of the respondents.

The employment status of the respondents were permanent 48.9% (2.39±0.074), contract 46.7% (2.64±0.159) while casuals were 4.4% (3±0.0)(Fig.5).

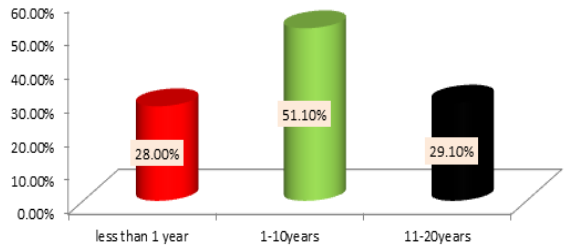

Figure 5. duration of employment of the respondents.

51.1% (2.61±0.96) of the respondents had worked for 1-10years, 11-20 28.9% (2.81±0.136) 11-20 years while 20% (2±0.243) having worked for less than a year. 66.6% (2.35±0.95) worked for more than 8 hours daily while 28.9% (2.77±0.139) worked for 1-4 hours daily and 4.4% (4±0) worked for between 5-8 hours (Fig.6).

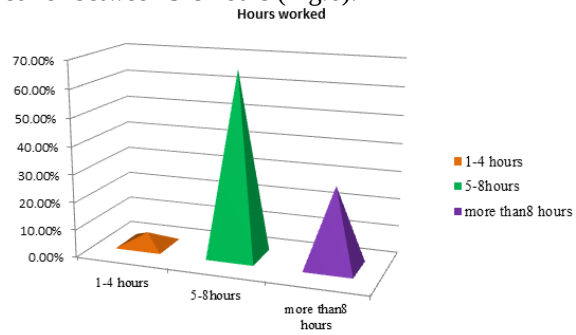

Figure 6. number of hours worked daily by the respondents.

Biomedical waste management practices

57.8 %(1.18±0.041) reported to have been provided with the recommended red, yellow, and black color-coded

waste containers. 17.8% (1.03±0.03) indicated that they are provide with red and black coded waste containers whereas 24.4 %(1.16±0.012) were provided with only black (Fig.8).

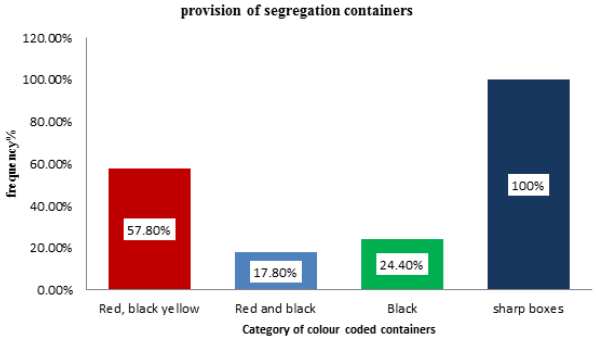

Figure.7 color-coded containers provided.

77.8%(1.22±0.044) reported to correctly dispose anatomical waste in the red containers. 21.2 %(1.12±0.32) disposed the anatomical waste into black coded containers. The contaminated materials were correctly disposed in yellow coded containers by only 17.8 %(1.62±0.081) of the respondents while a majority 55.6% deposited them in the red coded containers. 91.1 %(3.82±0.060) disposed used medical sharps in safety boxes while all the respondents indicated to dispose general wastes into black coded containers. 57.8 % (1.51±0.069) admitted to always segregate biomedical waste upon disposal while 33.3% occasionally, and 8% not at all (fig.9). Inadequacy of color coded waste containers was the main reason at 37.8%(for not segregating biomedical wastes while 4% indicated to lack the knowhow(2.2±0.010).

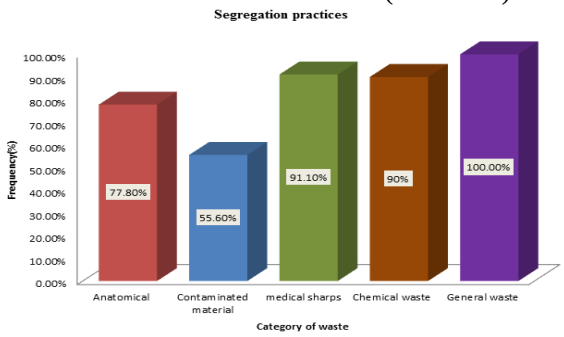

Figure.8. segregation practices .

88.8 %(mean=3.08±0.06) of the respondents indicated the availability of waste disposal sites and 86.7 %(1.09±0.030) reported availability of temporary storage for biomedical waste before disposal. All the respondents indicated utilization of incinerators as a facility for the treatment of biomedical waste. 13.3 %(1.87±0.036) used autoclaving method, 48.9 %(1.51±0.053), land disposal, 77.8 %(1.22±0.044) burial, and 82.2 %(1.18±0.040) burned the wastes (Fig.9).

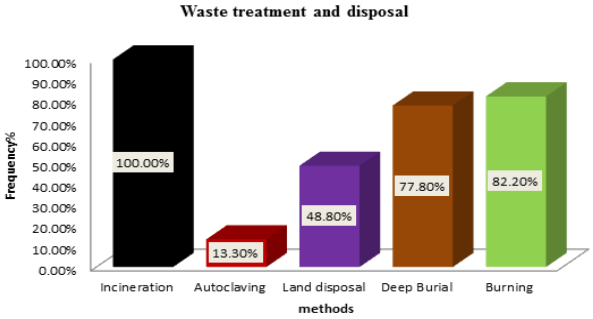

Figure.9 waste treatment and disposal .

Containers were mostly used to transport the biomedical wastes at 50 %(1.80±0.06) while wheelbarrows and wheeled trolleys at 15.6 %(1.64±0.133) and 34.4 %(1.39±0.089) respectively. Whereas 85.6%(1.64±0.133) collected the wastes daily none of the respondents indicated to have been weighing and recording the wastes generated. 77.8 %(1.53±0.061) indicated to correctly dispose sharps containers when they were ¾ full and 22.2% (2±0.001) continued to use sharps containers until they were completely full. 52.2% (1.67±0.08) had adequately access to personal protective equipments and notably, 30%(1.23±1.065) of the respondents reported to utilize Personal protective equipment (PPE). 66.7% (1.42±0.0142) admitted to occasionally use the personal protective equipment.

Implementation of safety practices by the facilities

76.7%(1.65±0.058) of the respondents felt that used medical sharps were well managed. 72.2% (1.63±0.051) indicated that there was provision of vaccination services while all (100%) had access to post exposure prophylaxis services. Provision of training on health and safety was found to be inadequate with 36.7% (1.39±0.086) satisfied with the practice. At least 61.1% (1.71±0.077) were contented with the availability of the PPE but 85.6 %(1.62±0.140) indicated that a lot more should be done in formation of health and safety committees (Fig.10).

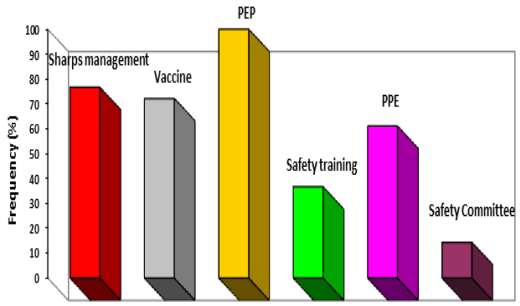

Figure 10. implementation of waste management practices.

Table 2. Observational findings on segregation and disposal of biomedical waste.

OBSERVATION	YES	NO
	%	%
Availability of waste segregation guidelines	66.4	33.6
Availability of Red color coded waste containers	69.8	30.2
Availability of Yellow color coded waste containers	58.5	41.5
Availability of Black color coded waste containers	100	0
Availability of Medical sharps containers	90.5	9.5
Presence of potentially infectious anatomical wastes e.g. tissues, body parts	85.2	14.8
Presence of potentially infectious blood and other body fluids	100	0
Presence of used medical sharps	100	0
Presence of chemical wastes	100	0
Presence of food stuff wastes	100	0
Presence of paper wastes	100	0
Proper segregation of wastes	52.7	47.3

Observation Chart Finding

Waste generated and segregation

66.4 %(1.32±0.021) of the sites observed had waste segregation guidelines displayed at designated points to guide in proper utilization of the color-coded containers. In 69.8 % (1.54±0.0321) of the areas surveyed had red and yellow coded containers respectively. Whereas in all the areas (100%) had the black color-coded containers. In 90.5 %(1.61±0.0124) of the sites, medical sharp containers were available. Disposal of potentially infectious anatomical wastes were observed in 85.2 %(1.21±0.027) of the locations surveyed. Potentially infectious blood and other body fluids, medical sharps, chemical, paper, and foodstuff wastes were observed in all the sites. Conclusively, in 52.7 %(1.61±0.089) of the sites surveyed, there was proper segregation of the wastes (Table 2).

Transportation and waste disposal

In the three Sub-County hospitals, 6 areas were surveyed to determine transportation and disposal of wastes. Wheelbarrows were used in 4(1.68±0.098) out of the six areas. 1(2±0.000) facility used a cart whereas trolleys were used in five of the locations. It was observed that at least in 5(1.78±0.098) of the locations, wastes were transported using hand containers. It was noted that all the facilities had designated waste disposal areas but in only 5(1.76±0.091) had temporary storage facilities where 4(1.61±0.092) were in good working condition. None of the facilities weighed nor kept records of the waste generated (Table 3).

Methods of biomedical wastes treatment in place

For the treatment of wastes generated, incineration, land disposal, autoclaving, and chemical, methods were applied in all the three healthcare facilities. Only 2(1.21±0.100) of the hospitals practiced deep burial of biomedical wastes. The incinerator was found to be in good working condition in all the facilities (Table 4).

Table 4. Methods of biomedical wastes treatment.

OBSERVATION	YES	NO
	%	%
Treatment through incineration	3	0
Treatment through land disposal	3	0
Treatment through deep burial	1	2
Treatment through burning	3	0
Treatment through autoclaving	3	0
Treatment through chemical treatment	3	0
Incinerator in good working condition	3	0

Usage of personal protective equipment

Among the 90 participants, 91.7 %(1.23±0.061) were observed to don, remove, and dispose the hand gloves correctly. Only 56.1 %(1.60±0.071) and 24.5 %(1.26± 0.078) wore protective clothes/gowns and footwear respectively. When carrying out procedures, 76.8 %(1.52± 0.021) of the workers were found to wear facial protection as a form of personal protective gear (Table 5).

Table 5. Usage of Personal protective equipment.

OBSERVATION	YES	NO
	%	%
Dons, removes, and disposes gloves correctly.	91.7	8.3
Wears protective clothing/gowns	56.1	43.9
Wears protective footwear	24.5	75.5
Wears facial protection	76.8	23.2

Discussion

Provision of color-coded containers was important in determining frequency of segregation practice among the respondents with positive correlation coefficient of 0.82. All professionally trained staff, new segregation of sharps correctly by use of safety boxes, This due to training they receive while undergoing professional training. Inadequate supply of the bags attributed the poor color-coding segregation which mainly training medical staff who new proper color-coding segregation. (F=2.85, P=0.02), Contaminated waste (F= 2.361, P=0.047), Medical sharps (F=3.871, P=0.03). (This was inconsistent with findings in study done at Kenyatta National hospital (Njiru.M., 2015) where nursing staff had the least level of awareness in waste segregation at 40% and doctors at 50% while support staff at 51%. This may be due to tools of measurement as well as calibration method used.

The global guiding principles of waste management form a basis of waste management. Clinical officers, lab technologists and medical doctors were aware of the precautionary rule while 60% of nurses were conversant with the precautionary rule where as none of the sanitary staff was familiar with the rule. There was a positive correlation coefficient between awareness of precautionary rule, and proper segregation of anatomical waste 0.822, 0.922 infectious materials and 0.365 of sharp containers. This indicates precautionary principle plays an important role in hospital waste management. This also concurs with Oli *et, al* 2015 finding in the studies done in health facilities in Nigeria where medical trained staff in government hospital had above average knowledge on waste management and segregation.

Conclusions

1. The sub county hospitals in Mombasa county have deficient waste management practices including poor segregation and handling practices which is due to lack of adequate regular supply of segregation materials and training programs on biomedical waste management.
2. Waste management guidelines were also not readily accessible by most of the healthcare workers.

Recommendations

1. The frequency and quality of training on infection prevention, control, and biomedical handling practices should be augmented in order to improve levels of knowledge, awareness, and consequently on adherence to acceptable biomedical waste handling practices.

Table 3. showing findings of waste transportation to disposal site.

OBSERVATION	YES	NO
	%	%
Utilization of wheelbarrows	4	2
Utilization of cart	1	5
Utilization of trolleys	5	1
Utilization of hand containers	5	1
Transportation apparatus in good working condition	4	2
Presence of a specific area for health care waste disposal	6	0
Presence of a temporary storage premise large enough to handle the waste generated	5	1
Temporary storage facility in good working condition	4	2
Weighing and keeping records of the waste generated	0	6

2. Regular infection prevention and control measures such as sterilization and fumigation of the health care facilities and equipments should be put in place to prevent the growth of infectious microbes.
3. Proper and timely collection, segregation, disposal, and treatment of biomedical wastes should be implemented. For instance, all health care facilities should be installed with fully functional and well-maintained incinerators..
4. More study should be done to establish Role of private waste management firm in poor biomedical waste management in Kenya.

REFERENCES

Ajit, D. and Amitava, M. (2014). Challenges of Bio-Medical Waste Accumulation and Management in Urban Areas: A Study of Itanagar Town of Arunachal Pradesh. *Reviews of Literature Impact Factor*: 1.4716 (UIF) Volume 2, Issue 3/Oct2014 ISSN:-2347-2723.

Chartier**, Y., Emmanuel, J., Pieper, U., Pruss, A., Rushbrook, P., Stringer, R., Townsend, W., Wilbum, S. and Zghondi, R.** (2014). Safe Management of Waste from Healthcare Activities.*Publications of the World Health Organization (WHO) (www.who.int), 20 Avenue Appia, 1211 Geneva 27*, Switzerland.

Debnath, A., Mitra, A. (2014). Challenges of Bio-medical waste Accumulation and Management in Urban Areas: Aof Itanagar Town of Arunachal Pradex. Review of Literature Impact Factor: 1.4716(UIF) Volume 2, Issue 3/oct 2014 ISSN: 2347-2723.

Kamalakanta, M., Akhilesh, B. (2015). Challenges to Waste Management Practices in Indian Health Care Sector.*2012 International Conference on Environment Science and Engineering IPCBEE vol.3 2(2012) © (*2012) IACSIT Press, Singapoore.

Kei, R. M. and Njagi, A.N. (2013). Management of Health-Care Waste: A Case Study of Two National Teaching and Referral Hospitals in Kenya. *Journal of Emerging Trends in Engineering and Applied Sciences* (JETEAS) 4 (4): 588-593. Scholar link Research Institute Journals, 2013 (ISSN: 2141-7016).

Kuchibanda, K. and Mayo, A.W. (2015). Public Health Risks from Mismanagement of Healthcare Wastes in Shinyanga Municipality Health Facilities, Tanzania. *Scientific World Journal Volume 2015, Article ID981756, 11 pages http://dx.doi.org/10.1155/2015/981756* Hindawi Publishing Corporation.

Kungu, R.E., Njogu, P.M and J. Kiptoo, J. (2016). Evaluation of Health Care Waste Management in Selected Health Facilities in Kiambu County, Kenya. *Journal of Agriculture science and Technology (JAGST) Vol.17 (1) 2016*. Institute for Energy and Environmental Technology, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

Manasi, S., Umamani, K. and Latha, N. (2014). Biomedical Waste Management: Issues and Concerns - A Ward Level Study of Bangalore City. *The Institute for Social and Economic Change.ISBN 978-81-7791-168-8* 2014, Copyright Reserved, Bangalore

Manyele, S. and Lyasenga, T.V. (2010). Factors Affecting Medical Waste Management in Low-level Health Facilities in Tanzania.*African Journal of Environmental Sciences and Technology Vol.4(5). PP.304-318, May 2010 ISSN 199-637X.*

MOH (2016). Health Care Waste Management Plan 2016–2021.

Muluken, A., Hamanot, G., Molla (2013). Health Care waste Management Practices among Healthcare Workers in Healthcare Facilities of Gondor Town Northeast Ethiopia. *Journal for Health Sciences Vol. 7 (2013) Issue 3.*

NashaatMazrui (2010). Medical Waste Management in Kenya: Opportunities for Improvement.

Ndejjo, R., Musinguzi, G., Xiaozhong, Y., Buregyeya, E., Musoke, E., Sheng Wang, J., Halage, A.A., Christopher, W., Bazeyo, W., Phillip, W., Ssempebwa, J. (2015). Occupational Health Hazards among Healthcare Workers in Kampala, Uganda. *Journal of Environmental and Public HealthVolume2015,ArticleID913741,9*pageshttp://dx.doi.org/10.1155/2015/913741. Hindawi Publishing Corporation

Njiru, M.N. (2015). Assessment of the Awareness and Practice on Medical Waste ManagementamongHealthcare Personnel at Kenyatta National Hospital in Nairobi. *Jomo Kenyatta University of Agriculture and Technology Repository.*

Njue, P.M., Cheboi, K.S and Oiye, S. (2015). Adherence to Healthcare Waste Management Guidelines among Nurses andWasteHandlersinThikaSubCountyHospitalKenya.*Ethiopian Journal for Health Science. 2015 Oct; 25(4): 295–304.*

Praveen, M., Sangeeta, P. and Anand, S. S. (2012). Need of Biomedical Waste Management System in Hospitals - An Emerging issue - A Review. *Journal of CurrentWorld annual Environment Department of Environmental Science*, MDS UniversityAjmer - 305 009 (India) Vol. 7 (1), 117-124(2012).

Ramesh, S.T., Jayanthi, S. and R. Gandhimathi, R. (2008). Management of Biomedical Waste and Remedial Measures. *Department of Civil engineering, Journal of Industrial pollution control* 24 (2) (2008) pp 147-150.Enviromedia Government College of Technology, Coimbatore 13, India.

Shvalli, S. and Sowmyashree, H. (2015). Occupational Exposure to Infections: Study on Healthcare Waste Handlers of Tertiary Care Hospital in South India. *Journal of the Association of Physicians of India Vol. 63 Nov 201.*

Sohrab, H., Norulaini, N.R, Venugopal, B., Vignesh, R.P., Zaidul, I.S and Omar, M.K. (2013). Infectious Risk Assessment of Unsafe Handling Practices and Management of Clinical Solid Waste. *International Journal Environmental ResearchandPublicHealth2013*,10,556567;doi:10.3390/ijerph10020556.

Udofia, E.A., Fobil, J.N., Gabriel, G. (2015). Solid Waste Management in Africa. *African Journal of Environmental Science and Technology Vol. 9(3) PP. 244-254 March 2015.Doi:10.58997/AJEST2014-1851ISSN1996-0786.*

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